CASIO®

OPERATION MANUAL
MANUAL DE OPERACION

SA09259806C 英西 Printed in Japan

英西

Dear customer,
Thank you very much for purchasing our scientific calculator.
This high-performance, pocket-size calculator employs true algebraic logic (judging the precedence of operations) and allows the use of up to 18 nesting parentheses at six levels. Its major features are 74 functions, seven memory registers, regression analysis, and up to 135 programmable steps for repeated calculation.
This booklet will familiarize you with the many ways this highly capable unit can serve you.

* *Special care should be taken not to damage the unit by bending or dropping. For example, do not carry it in your hip pocket.*

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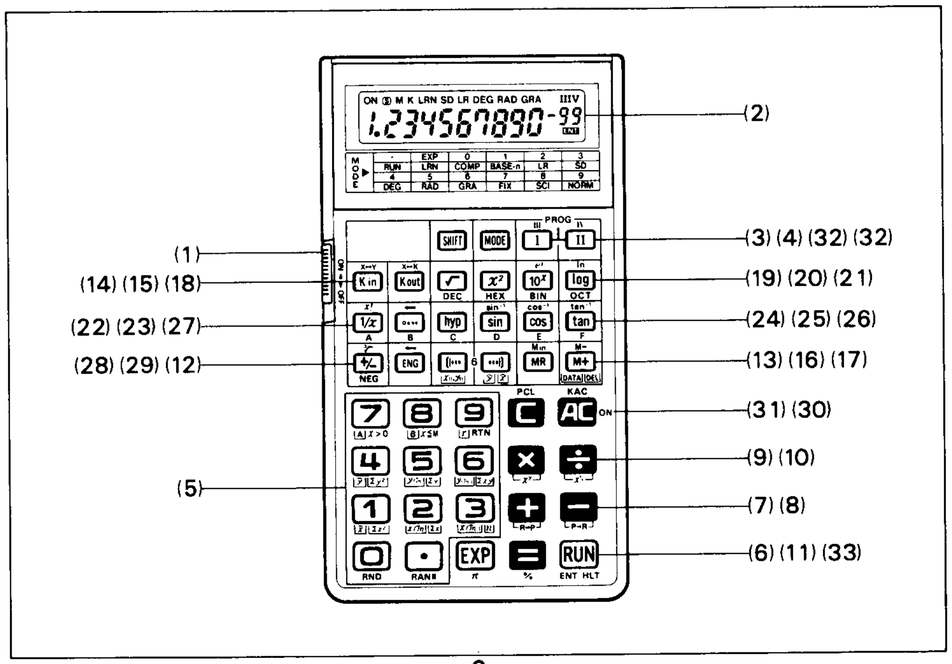
■ Internal registers (user registers)

X-register (display) Y (L1)-register	• Used in arithmetic and functional calculations
L2-register L3-register L4-register L5-register L6-register	• Used in calculations with nesting parentheses and for judging the precedence of addition/subtraction and multiplication/division.
M-register	• Independent memory register (MR, M+, M−, MR)
K1 (Σx^2) register K2 (Σx) register K3 (n) register K4 (Σy^2) register K5 (Σy) register K6 (Σxy) register	• Constant memory registers (Kin, Kout, 1 − 6) • For storing intermediate results (Σx^2, Σx, n, etc.) of statistical calculations.

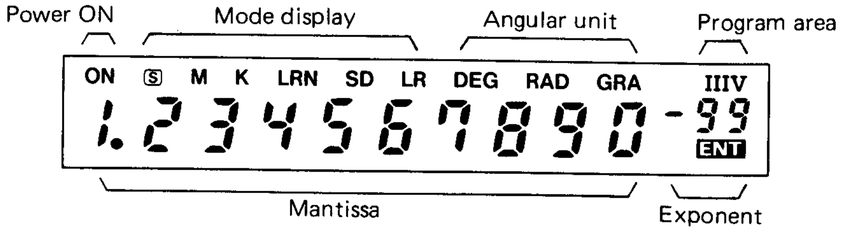
1/NOMENCLATURE



(1) Power switch

Slide the power switch up to activate the calculator and "ON" is displayed. Even when power is off, the contents held in independent memory and constant memory registers, and the programs are not lost.

(2) Display



The display shows input data, intermediate results and results of operation. The mantissa section displays up to 10 digits (9 for negative numbers). The exponent section displays up to ±99.
The hexadecimal display and angle in the sexagesimal scale are displayed as follows.

$ABCDEF_{16}$ (11259375_{10}) is displayed . . . **AbCdEF.** H

12°34'56.7" is displayed . . . . . **12°34°56.7**

"E" (error check, see page 11) may be displayed in the position of the mantissa's least significant digit. "DEG", "RAD" or "GRA" (angular unit), "S" (when the SHIFT key has been pressed), "M" (when data is stored in independent memory), "K" (during calculation with constants), "SD" (during calculation of standard deviation), "LR" (during calculation of regression analysis), and/or "I", "II", "III" or "IV" (program area), as well as "LRN" and "ENT" will be displayed to indicate the operating mode.

Auto power-off

If the calculator is left with the power switch at the "ON" position (except while programmed calculation), the auto power-off function automatically turns off the power in approximately 6 minutes, thereby saving battery life. Power is resumed either by pressing the AC key or by re-operating the ON-OFF switch.
(Even when power is off, the contents of memories and written programs as well as the angular unit and operating mode are not lost.)

(3) SHIFT Shift key

Activates the functions printed in brown on the keyboard.
When the SHIFT key is pressed, "S" appears on the display and the subsequent pressing of SHIFT makes "S" disappear.

(4) MODE Mode key

To put the calculator into the desired operating mode or select a specific angular unit, press MODE first, then EXP, ·, 0, 1 . . . . . , or 9.
See page 9 for detail on the operation mode and calculation mode.

- MODE EXP : "LRN" is displayed. Program can be written.
- MODE · : Manual calculations and program execution can be performed.
- MODE 0 : Arithmetic calculations and function calculations can be performed.

- MODE 1 : Binary/octal/decimal/hexadecimal conversions and calculations can be performed.
- MODE 2 : "LR" is displayed. Calculation of regression analysis can be executed.
- MODE 3 : "SD" is displayed. Calculation of standard deviation can be executed.

* To carry out manual or programmed calculation, select the RUN mode (press MODE and ·).

- MODE 4 : "DEG" is displayed, indicating that "degrees" is selected as the unit of angle.
- MODE 5 : "RAD" is displayed, indicating that "radians" is selected as the unit of angle.
- MODE 6 : "GRA" is displayed, indicating that "grads" is selected as the unit of angle.

(Note: 90 degrees = $\pi/2$ radians = 100 grads)

- MODE 7 : "Fix" assignment (assignment for the number of fractional digits). Specify the number of digits of the fractional part after pressing MODE and 7. (Example: MODE 7 3 (three fractional digits are effective))
- MODE 8 : "Scientific" assignment (assignment for the number of significant digits). Specify the number of significant digits after pressing MODE and 8. (Example: MODE 8 4)
- MODE 9 : "Normal" assignment. Press in this sequence to release the "fix" or "scientific" assignment.

* Once power is off, the "fix" and "scientific" assignments will be released but the operating mode ("LRN", "LR" or "SD") and the angular unit ("DEG", "RAD" or "GRA") will be kept.

(5) 0 — 9, · Numeral and decimal point keys

Enters numerals. For decimal places, use the · key in its logical sequence.

* Varying functions will be designated when you press SHIFT and a numeral key, as summarized below.

- SHIFT 0 (RND) : Cutting off internal data
  The internal data (held in the Y-register) will be cut off so as to be equal to the displayed data.
- SHIFT · (RAN#) : Random number generation
  A random number between 0.000 and 0.999 will be generated.

* Use following sequences in calculation of standard deviation and in regression analysis. For more details, refer to the chapter 7 "STATISTICAL CALCULATIONS".

- SHIFT 1 ($\bar{x}$) : Calculation of $\bar{x}$ (average of x)
- SHIFT 2 ($x\sigma_n$) : Calculation of $x\sigma_n$ (population standard deviation of x)
- SHIFT 3 ($x\sigma_{n-1}$) : Calculation of $x\sigma_{n-1}$ (sample standard deviation of x)
- SHIFT 4 ($\bar{y}$) : Calculation of $\bar{y}$ (average of y)
- SHIFT 5 ($y\sigma_n$) : Calculation of $y\sigma_n$ (population standard deviation of y)
- SHIFT 6 ($y\sigma_{n-1}$) : Calculation of $y\sigma_{n-1}$ (sample standard deviation of y)
- SHIFT 7 (A) : Calculation of A (constant terms in regression equations)
- SHIFT 8 (B) : Calculation of B (regression coefficients)
- SHIFT 9 (r) : Calculation of r (correlation coefficients)

* Different functions will be designated when you press [Kout], then a numeral key as summarized below.

- [Kout] [1 Σx²] : Calculation of Σx^2 (square sum of x)
- [Kout] [2 Σx] : Calculation of Σx (total sum of x)
- [Kout] [3 n] : Calculation of n (number of data)
- [Kout] [4 Σy²] : Calculation of Σy^2 (square sum of y)
- [Kout] [5 Σy] : Calculation of Σy (total sum of y)
- [Kout] [6 Σxy] : Calculation of Σxy (inner product)

* Use [SHIFT] [7 x≥0], [SHIFT] [9 x≥M] and [SHIFT] [9 RTN] only for writing programs (in "LRN" mode).

- [SHIFT] [7 x≥0]: Conditional jump
  "Return to the first step of the program when the contents of the X-register (display) is positive and otherwise go to the next step."
- [SHIFT] [9 x≥M]: Conditional jump
  "Return to the first step of the program when the contents of the X-register is equal to or smaller than those of the M-register (independent memory) and otherwise go to the next step."
- [SHIFT] [9 RTN]: Unconditional jump ("Return")
  Press these keys to return to the first step of the program unconditionally.

(6) [EXP π] Exponent/Pi entry key

- Enters the exponent of ten up to ±99. To enter 2.34 x 10^{56}, for example, press [2] [.] [3] [4] [EXP] [5] [6] in sequence **(symbolized by [EXP])**.
- Enters circular constant in 10 digits (3.141592654) when pressed after [AC], [C], [=], [SHIFT] or a function command key **(symbolized by [π])**.

(7) [+ R→P] Addition/Rectangular → polar key

- Enters summands.
- Performs rectangular to polar co-ordinates conversion when pressed after the [SHIFT] key.

(8) [− P→R] Subtraction/Polar → rectangular key

- Enters minuend.
- Performs polar to rectangular co-ordinates conversion when pressed after the [SHIFT] key.

(9) [× x^y] Multiplication/Power key

- Enters multiplicand.
- Raises the base x to yth power when pressed after the [SHIFT] key.

(10) [÷ x^1/y] Division/Root key

- Enters dividend.
- Calculates the yth root of x when pressed after the [SHIFT] key.

(11) [= %] Equal/Percent key

- Obtains answer.
- Perform regular percentages, add-ons, discounts, ratios and increase/decrease values when pressed after the [SHIFT] key.

(12) [(••• x,y] Open parenthesis/Regression analysis data input key

- Opens the parentheses. Nesting of up to 18 parentheses at six levels is allowed.
- Enters data (x) in regression analysis ("LR" mode).

(13) [•••) ŷ|x̂] Close parenthesis/Regression analysis estimator key

- Closes the parentheses.
- Obtains an estimator of regression in regression analysis ("LR" mode). $\hat{y}$ will be obtained if you press it immediately after data entry and $\hat{x}$ if you press it following [SHIFT] key after data entry.

(14) [X↔Y Kin] Constant memory entry/Register exchange key

- Enters numbers into each constant memory, through operation of ENTRY [Kin] [1] (to [6]).

Example: To enter 12.3 into constant memory 3.
12 [.] 3 [Kin] [3]

- Exchanges the displayed number (X-register) with the content of the working register (Y-register) when pressed after the [SHIFT] key.
(Shift operations throughout this manual is indicated as [SHIFT] [X↔Y].)

(15) [X↔K Kout] Constant memory recall/Register exchange key

- Recalls the contents in each constant memory without clearing, through operation of [Kout] [1] (to [6]).

Example: To recall the contents of constant memory 5.
[Kout] [5]

- Exchanges the displayed number (X-register) with the contents of a constant memory (K-register) when pressed after the [SHIFT] key.

Example: To exchange the contents of constant memory 2 with the displayed number.
[SHIFT] [X↔K] [2]

(16) [Min MR] Independent memory recall/Independent memory entry key

- Recalls the contents of the independent memory (M-register) without clearing.
- Puts the displayed number in the independent memory when pressed after the [SHIFT] key. Old data held in the memory will be automatically erased.

(17) [M− M+ DATA/DEL] Memory plus (minus)/Data entry/delete key

- Adds the displayed number to the contents of the independent memory, and obtains answer in 4 basic calculations/x^y/$x^{1/y}$ and automatically adds it to the contents of the memory.
- Subtracts the displayed number from the contents of the independent memory, and obtains answer in 4 basic calculations/x^y/$x^{1/y}$ and automatically subtracts it from the contents of the memory when pressed after the [SHIFT] key.
- The data entry/delete mode is specified when LR or SD is displayed.

  [DATA] .... Input ≪data [DATA]≫ when SD is displayed and ≪x-data [x_0,y_0] y-data [DATA]≫ when LR is displayed.

  [SHIFT] [DEL] .. To delete data, substitute [SHIFT] [DEL] in place of [DATA] in the above procedure.

(18) [√ DEC] Square root key

- Obtains the square root of the displayed value.
- Inputs or converts a decimal value in the BASE-n mode.

(19) [x² HEX] Square key

- Squares the displayed value.
- Inputs or converts a hexadecimal value in the BASE-n mode.

(20) [10^x e^x BIN] Antilogarithm/Exponential key

- Obtains the xth power of 10 for of displayed value.

- Obtains the xth power of e (2.718281828) of the displayed value when pressed after the [SHIFT] key.
- Inputs or converts a binary value in the BASE-n mode.

(21) [log] / [ln] / [OCT] Common logarithm/Natural logarithm key

- Obtains the common logarithm (base 10) of the displayed value.
- Obtains the natural logarithm (base e=2.7182818. . .) of the displayed value when pressed after the [SHIFT] key.
- Inputs or converts an octal value in the BASE-$n$mode.

(22) [1/x] / [x!] / [A] Reciprocal/Factorial key

- Obtains the reciprocal of the displayed value.
- Obtains the factorial of the displayed value when pressed after the [SHIFT] key.

(23) [←] / [°'"] / [B] Sexagesimal/Decimal conversion key

- Converts the sexagesimal figure to decimal notation.
- Converts the decimal notation to sexagesimal notation when pressed after the [SHIFT] key.

(24) [sin] / [sin⁻¹] / [D] Sine/Arc sine key

- Obtains the sine of the displayed angle.
- Obtains the angle when pressed after the [SHIFT] key.

(25) [cos] / [cos⁻¹] / [E] Cosine/Arc cosine key

- Obtains the cosine of the displayed angle.
- Obtains the angle when pressed after the [SHIFT] key.

(26) [tan] / [tan⁻¹] / [F] Tangent/Arc tangent key

- Obtains the tangent of the displayed angle.
- Obtains the angle when pressed after the [SHIFT] key.

(27) [hyp] / [C] Hyperbolic key

- Obtains the hyperbolic functions in combination with the [sin], [cos] or [tan] key.
- Obtains the inverse hyperbolic functions in combination with the [sin], [cos] or [tan] key when pressed after the [SHIFT] key.

* Keys [(-)/A] through [tan/F] are used in the BASE-n mode for input of hexadecimal values A_{16} through F_{16} ($10_{10} - 15_{10}$).

(28) [(-)] / [∛] / [NEG] Sign change/Cube root key

- Changes the sign of the displayed value from positive to negative or vice versa. Also changes the sign of the exponent when pressed after the [EXP] key.
- Obtains the cube root of the displayed value when pressed after the [SHIFT] key.

(29) [ENG] Engineering key

Allows the displayed number to be shown with exponents of ten that are multiples of three (e.g., 10^3, 10^{-6}, 10^9).

Ex.) 12⊡3456

	12.3456
[ENG]	12.3456 00
[ENG]	12345.6 -03
[ENG]	12345600. -06
[ENG]	12345600. -06

12⊡3456

	12.3456
[SHIFT] [ENG]	0.0123456 03
[SHIFT] [ENG]	0.000012345 06
[SHIFT] [ENG]	0.000000012 09
[SHIFT] [ENG]	0.000000012 09
[ENG]	0.000012345 06
[ENG]	0.0123456 03

(30) [AC] / [ON] All clear key

- Clears the entire machine except the independent and constant memories, and also releases overflow or error check.
- Clears contents of all constant memories when pressed after the [SHIFT] key.
- It also overrides the auto power-off function.

(31) [C] Clear key

- Clears entry for correction.
- Press [SHIFT] [C] to clear programs while LRN is displayed.

(32) [I] [II] [III] [IV] Program area keys

This calculator is capable of holding four programs up to 135 steps in total. I(II) will be designated when you press [I] ([II]) and III(IV) when you press it after the [SHIFT] key. A program area must be designated for executing a programmed calculation.

(33) [RUN] RUN/ENT/HLT key

■When a program is being written, depression of this key writes a halt instruction.

In the programmed operation mode, depression of this key restarts execution which has been temporarily suspended.

- [ENT] : When "LRN" is displayed (i.e.during program loading), depression of this key writes a halt instruction for data entry.
- [SHIFT] [HLT] : When "LRN" is displayed, depression of this sequence writes a halt instruction for the display of a result.
- [RUN] : When execution is at a halt during programmed operation, depression of this key restarts execution.

2/BATTERY MAINTENANCE

One lithium battery (Type: CR2025C) gives approximately 1300 hours continuous operation.
When battery power decreases, the whole display darkens. Battery should then be renewed. Be sure to switch OFF the power before changing.

1) Slide open the battery compartment lid on the back of the unit.
2) Remove dead battery and insert new battery with the plus terminal (flat side) on top.
3) Replace the battery compartment lid.
4) Press [MODE] [.] [SHIFT] [AC] [AC] [SHIFT] [MR] [MODE] [EXP] [SHIFT] [C] [MODE] [4] [MODE] [9] [MODE] [1] [DEC] [MODE] [0] [MODE] [.] in sequence.

* Before inserting the new battery, be sure to thoroughly wipe it off with a dry cloth to maintain good contacts.
* Never leave dead battery in the battery compartment.
* Remove the battery when not using for an extended period.
* It is recommended that battery be replaced every 2 years to prevent the chance of malfunctions due to battery leakage.
* Keep the batteries away from children. If swallowed consult your doctor immediately.

3/BEFORE USING THE CALCULATOR

■Operation mode and calculation mode

Two different modes are available for calculations and the mode used depends on the type of calculation being performed. The operation mode is used for manual calculations and program storage. The calculation mode is used for standard calculations, as well as binary/octal/decimal/hexadecimal calculations, standard deviation, and regression calculations.

- Operation mode

(1) RUN mode (MODE ·)
Used for manual calculations, program execution, and calculations including functions.

(2) LRN mode (MODE EXP)
Used for program storage and erase (LRN displayed).

- Calculation mode

(1) COMP mode (MODE 0)
Used for standard calculations including function calculations.

(2) BASE-*n* mode (MODE 1)
Used for binary/octal/decimal/hexadecimal conversions and calculations. Cannot be used for function calculations.

(3) LR mode (MODE 2)
Used for regression calculations (paired variable statistics) (LR displayed).

(4) SD mode (MODE 3)
Used for standard deviation calculations (SD displayed). The modes (operation/calculation) are retained when power is switched OFF. Always check the current mode in effect before beginning calculations.

■ Precedence of operations and precedence levels

- This calculator automatically evaluates precedence of operations and executes in the proper sequence thus determined. The precedence of operations is as follows.

① Functions
② x^y, $x^{\frac{1}{y}}$
③ Multiplication and division
④ Addition and subtraction

Operations of the same precedence will be carried out in the order of input. An expression enclosed with a pair of parentheses will be given the highest precedence level.

- Internal registers L1 to L6 are used to retain intermediate results of operations, including expressions enclosed with parentheses, which have low precedence levels. Therefore, intermediate results of up to six levels may be retained.
- Up to three nested parentheses will be given the same precedence level. As a result, parentheses can be nested up to 18 pairs.

* How to evaluate precedence levels (an example of 4 levels and 5 pairs of nested parentheses)

Expression: $2\times\{\{(3+4\times\{(5+4)\div3\})\div5\}+9\}=$

Entry operation: 2 × ((3 + 4 × ((5 + 4) ÷ 3)) ÷ 5) + 9 =

1 level 1 level 1 level 1 level

Ⓐ

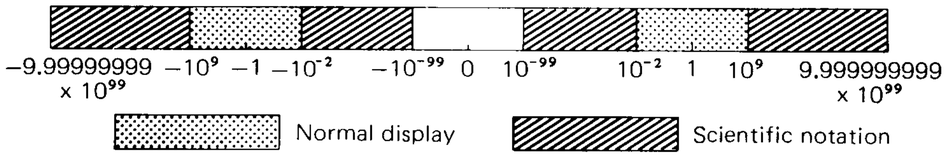
Contents of registers when entry has proceeded to Ⓐ

X	4
L1	((5+
L2	4×
L3	(((3+
L4	2×
L5	
L6	

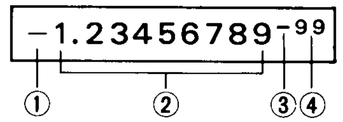
■Correction

- If you are aware of data entry error before pressing a command key, press C and re-input the correct data.
- In a series of calculations, you can correct a wrong intermediate result of a functional calculation or within nested parentheses: press C and calculate the correct value, then resume the interrupted sequence of calculations.
- If you have pressed +, −, ×, ÷, SHIFT $\sqrt[x]{\ }$ or SHIFT $\sqrt[\square]{\ }$ by mistake, you may press the correct key immediately. Note that, though the correct operation overrides the wrong one designated first, the precedence of operation of the first command remains effective.

■Calculation range and scientific notation



When the answer exceeds the normal display capacity, it is automatically shown by scientific notation, 10-digit mantissa and exponents of 10 up to ±99.



① The minus (−) sign for mantissa
② The mantissa
③ The minus (−) sign for exponent
④ The exponent of ten

The whole display is read: $-1.23456789\times10^{-99}$

* Entry can be made in scientific notation by using the EXP key after entering the mantissa.

EXAMPLE	OPERATION	READ-OUT
-1.23456789×10^{-3} (=−0.00123456789)	1 · 23456789 +/−	−1.23456789
	EXP	−1.23456789 00
	3 +/−	−1.23456789 −03

■Overflow or error check

Overflow or error is indicated by the "E" or "E" sign and stops further calculations.

Overflow or error occurs:

1) When an answer, whether intermediate or final, or accumulated total in the independent memory is more than 1×10^{100} ("E" sign appears).
2) When function calculations are performed with a number exceeding the input range ("E" sign appears).
3) When unreasonable operations are performed in statistical calculations ("E" sign appears).
   Ex.) You attempt to obtain $\bar{x}$ or σ_n without any input data ($n = 0$).
4) When the total number of levels of explicitly and/or implicitly (with addition-subtraction versus multiplication-division including x^y and $\sqrt[y]{x}$) nested parentheses exceeds six, or more than 18 pairs of parentheses are used.
   Ex.) You have pressed the ((key 18 times continuously before designating the sequence of 2 + 3 ×.

To release these overflow checks:

1), 2), 3) . . . . . Press the AC key.
4) . . . . . Press the AC key. Or press the C key, and the intermediate result just before the overflow occurs is displayed and the subsequent calculation is possible.

4/NORMAL CALCULATIONS

* Set the RUN mode (MODE ·) and COMP mode (MODE 0).
* Calculations can be performed in the same sequence as the written formula (true algebraic logic).
* Nesting of up to 18 parentheses at six levels is allowed.

4-1 Four basic calculations

* Parenthesis calculations can not be performed with the function mode at "LR".

EXAMPLE	OPERATION	READ-OUT
$23+4.5-53=-25.5$	23 + 4 · 5 − 53 =	−25.5
$56\times(-12)\div(-2.5)=268.8$	56 × 12 +/− ÷ 2 · 5 +/− =	268.8
$2\div3\times(1\times10^{20})=6.666666667\times10^{19}$	2 ÷ 3 × 1 EXP 20 =	6.666666667 19
$3+\underline{5\times6}\,(=3+30)=33$	3 + 5 × 6 =	33.
$\underline{7\times8}-\underline{4\times5}\,(=56-20)=36$	7 × 8 − 4 × 5 =	36.
$1+2-\underline{3\times4\div5}+6=6.6$	1 + 2 − 3 × 4 ÷ 5 + 6 =	6.6
$\frac{6}{4\times5}=0.3$	4 × 5 ÷ 6 SHIFT x⇄y =	0.3

* The number of depression of the ((key can be displayed.

$2\times\{7+6\times(5+4)\}=122$	2 × ((	Ⅽ01 0.
	7 + 6 × ((	Ⅽ02 0.
	5 + 4)))) =	122.
$(2+3)\times4=20$	((2 + 3)) × 4 =	20.
$\frac{3+4\times5}{5}=(3+4\times5)\div5=4.6$	((3 + 4 × 5)) ÷ 5 =	4.6

* It is unnecessary to press the)) key before the = key.

$10-\{7\times(3+6)\}=-53$	10 − ((7 × ((3 + 6 =	−53.

Another operation:

10 − ((7 × ((3 + 6)))) =

4-2 Assignment for the number of fractional digits and the number of significant digits

* To designate the number of fractional digits, press [MODE] [7] n in sequence.
  To designate the number of significant digits, press [MODE] [8] n .
* The "FIX" and/or "SCI" assignment will not be released until another assignment is made or [MODE] [9] is pressed. (Power-off and auto power-off release the assignments.)
* Even when "FIX" and/or "SCI" is assigned, internal data use 11-digit mantissa. Press in the sequence [SHIFT] [0 RND] to make the internal and displayed data equal.
* Press [ENG] and the data will be converted to representation with the exponent of which is a multiple of three.

EXAMPLE	OPERATION	READ-OUT
100÷6=16.66666666.....	100 [÷] 6 [=]	16.66666667
(Specifies four fractional digits)	[MODE] [7] [4]	16.6667
(Releases assignment)	[MODE] [9]	16.66666667
(Specifies five significant digits)	[MODE] [8] [5]	1.6667 01
	[MODE] [9]	16.66666667

* When an assignment for the number of digits is made, the data displayed is rounded up or down lowest digit position in the specified range but internal data remain unchanged in the registers. The assignment can be made at any time before or in the middle of calculation.

200÷7×14=400

	[MODE] [7] [3]	0.000
	200 [÷] 7 [=]	28.571
(Continues calculation with internal data consisting of 11 digits.)	[×] 14 [=]	400.000

To perform the same calculation with internal rounding

	200 [÷] 7 [=]	28.571
(Internal rounding)	[SHIFT] [0 RND] [×] 14 [=]	399.994
(Releases assignment)	[MODE] [9]	399.994
123m × 456 = 56088m	123 [×] 456 [=]	56088.
= 56.088km	[ENG]	56.088 03
78g×0.96=74.88g	78 [×] [.] 96 [=]	74.88
=0.07488kg	[SHIFT] [ENG]	0.07488 03

4-3 Constant calculations

* The "K" sign appears when a number is set as a constant.

EXAMPLE	OPERATION	READ-OUT
3+2.3=5.3	2 [.] 3 [+] [+] 3 [=]	K 5.3
6+2.3=8.3	6 [=]	K 8.3
7−5.6=1.4	5 [.] 6 [−] [−] 7 [=]	K 1.4
−4.5−5.6=−10.1	4 [.] 5 [+/−] [=]	K −10.1
2.3×12=27.6	12 [×] [×] 2 [.] 3 [=]	K 27.6
(−9)×12=−108	9 [+/−] [=]	K −108.
74÷2.5=29.6	2 [.] 5 [÷] [÷] 74 [=]	K 29.6
85.2÷2.5=34.08	85 [.] 2 [=]	K 34.08
17+17+17+17=68	17 [+] [+] [=]	K 34.
	[=]	K 51.
	[=]	K 68.
$1.7^2=2.89$	1 [.] 7 [×] [×] [=]	K 2.89
$1.7^3=4.913$	[=]	K 4.913
$1.7^4=8.3521$	[=]	K 8.3521
3×6×4=72	3 [×] 6 [×] [×]	K 18.
3×6×(−5)=−90	4 [=]	K 72.
	5 [+/−] [=]	K −90.
$\frac{56}{4\times(2+3)}=2.8$	4 [×] [(] 2 [+] 3 [)] [÷] [÷]	K 20.
	56 [=]	K 2.8
$\frac{23}{4\times(2+3)}=1.15$	23 [=]	K 1.15

4-4 Memory calculations using the independent memory

* When a new number is entered into the independent memory by the [Mrs] key, the previous number stored is automatically cleared and the new number is put in the independent memory.
* The "M" sign appears when a number is stored in the independent memory.
* The contents accumulated into the independent memory are preserved even after the power switch is turned off.
  To clear the contents press [O][SHIFT][Mrs] or [AC][SHIFT][Mrs] in sequence.

EXAMPLE	OPERATION	READ-OUT
53+6= 59	53 [+] 6 [=] [SHIFT] [Mrs]	M 59.
23−8= 15	23 [−] 8 [M+]	M 15.
56×2=112	56 [×] 2 [M+]	M 112.
+) 99÷4= 24.75	99 [÷] 4 [M+]	M 24.75
210.75	[MR]	M 210.75

7+7−7+ (2×3) + (2×3) + (2×3) − (2×3) =19

	7 [SHIFT] [Mrs] [M+] [SHIFT] [M−] 2 [×] 3 [M+] [M+] [M+] [SHIFT] [M−] [MR]	M 19.

12×3= 36	3 [×] [×] 12 [=] [SHIFT] [Mrs]	M K 36.
−) 45×3=135	45 [SHIFT] [M−]	M K 135.
78×3=234	78 [M+]	M K 234.
135	[MR]	M K 135.

4-5 Memory calculations using 6 constant memories

* When a new number is entered into a constant memory by operating ENTRY [Kin] ([1] to [6]), the previous number stored is automatically cleared and the new number is put in the constant memory.
* The contents stored in the constant memories are preserved even after the power switch is turned off.
  To clear the contents press [O][Kin][1] (to [6]) or [AC][Kin][1] (to [6]) in sequence.

EXAMPLE	OPERATION	READ-OUT
193.2÷23=8.4	193 [·] 2 [Kin] [1] [÷] 23 [=]	8.4
193.2÷28=6.9	[Kout] [1] [÷] 28 [=]	6.9
193.2÷42=4.6	[Kout] [1] [÷] 42 [=]	4.6

* Another operations by using the independent memory:
193 [·] 2 [SHIFT] [Mrs] [÷] 23 [=], [MR] [÷] 28 [=], [MR] [÷] 42 [=]

EXAMPLE	OPERATION	READ-OUT
$\frac{9\times6+3}{(7-2)\times8}$ =1.425	9 [×] 6 [+] 3 [=] [Kin] [1]	57.
	[⟵] 7 [−] 2 [⟶] [×] 8 [=] [Kin] [2]	40.
	[Kout] [1] [÷] [Kout] [2] [=]	1.425

* Calculations in constant memory registers can also be performed by using the [+], [−], [×] and [÷] keys.

	7 [Kin] [1] [×] 8 [Kin] [2] [×] 9 [Kin] [3] [=] [SHIFT] [Mrs]	M 504.
	4 [Kin] [+] [1] [×] 5 [Kin] [+] [2] [×] 6 [Kin] [+] [3] [M+]	M 120.
	3 [Kin] [+] [1] [×] 6 [Kin] [+] [2] [×] 9 [Kin] [+] [3] [M+]	M 162.
7 × 8 × 9=504	[Kout] [1]	M 14.
4 × 5 × 6=120	[Kout] [2]	M 19.
3 × 6 × 9=162	[Kout] [3]	M 24.
(Total) 14 19 24 786	[MR]	M 786.

12× (2.3+3.4) −5=63.4
30× (2.3+3.4+4.5) −15 ×4.5=238.5

12 [×] [⟵] 2 [·] 3 [+] 3 [·] [4] [⟶] [Kin] [1] [−] 5 [=]	63.4
30 [×] 4 [·] 5 [Kin] [+] [1] [SHIFT] [X⟷K] [1] [−] 15 [×] [Kout] [1] [=]	238.5

↓
To exchange the displayed number (4.5) with the contents of constant memory 1.

4-6 Percentage calculations

EXAMPLE	OPERATION	READ-OUT
12% of 1500 180	1500 [×] 12 [SHIFT] [%]	180.
Percentage of 660 against 880 . . 75%	660 [÷] 880 [SHIFT] [%]	75.
15% add-on of 2500 2875	2500 [×] 15 [SHIFT] [%] [+]	2875.
25% discount of 3500 2625	3500 [×] 25 [SHIFT] [%] [−]	2625.

EXAMPLE	OPERATION	READ-OUT
300cc is added to a solution of 500cc. What is the percent of the new volume to the initial one?	300 [+] 500 [SHIFT] [%]	160. (%)
If you made $80 last week and $100 this week, what is the percent increase?	100 [−] 80 [SHIFT] [%]	25. (%)
12% of 1200 144	1200 [×] [×] 12 [SHIFT] [%]	K 144.
18% of 1200 216	18 [SHIFT] [%]	K 216.
23% of 1200 276	23 [SHIFT] [%]	K 276.
26% of 2200 572	26 [×] [×] 2200 [SHIFT] [%]	K 572.
26% of 3300 858	3300 [SHIFT] [%]	K 858.
26% of 3800 988	3800 [SHIFT] [%]	K 988.
Percentage of 30 against 192 . . . . . 15.625%	192 [÷] [÷] 30 [SHIFT] [%]	K 15.625
Percentage of 156 against 192 . . . . . 81.25%	156 [SHIFT] [%]	K 81.25
600 grams was added to 1200 grams. What percent is the total to the initial weight? 150%	1200 [+] [+] 600 [SHIFT] [%]	K 150.
510 grams was added to 1200 grams. What percent is the total to the initial weight? 142.5%	510 [SHIFT] [%]	K 142.5
How many percent down is 138 grams to 150 grams? . . . . . down 8%	150 [−] [−] 138 [SHIFT] [%]	K −8.
How many percent down is 129 grams to 150 grams? . . . . . down 14%	129 [SHIFT] [%]	K −14.

5/BINARY/OCTAL/DECIMAL/ HEXADECIMAL CALCULATIONS

- Binary/octal/decimal/hexadecimal calculations and conversions are performed in the BASE-*n* mode ([MODE] [1]).
- Base values are set by pressing one of the following keys:

KEY	BASE	
[DEC]	Decimal	:
[HEX]	Hexadecimal	:
[BIN]	Binary	:
[OCT]	Octal	:

- Calculation range

BASE	DIGITS	RANGE
Binary	10	Positive : $0 \leqq x \leqq 111111111$
		Negative: $1000000000 \leqq x \leqq 1111111111$
Octal	10	Positive : $0 \leqq x \leqq 3777777777$
		Negative: $4000000000 \leqq x \leqq 7777777777$
Decimal	10	Positive : $0 \leqq x \leqq 9999999999$
		Negative: $-999999999 \leqq x \leqq 0$
Hexadecimal	8	Positive : $0 \leqq x \leqq 7FFFFFFF$
		Negative: $80000000 \leqq x \leqq FFFFFFFF$

- Valid values

BASE	VALUES
Binary	0, 1
Octal	0, 1, 2, 3, 4, 5, 6, 7
Decimal	0, 1, 2, 3, 4, 5, 6, 7, 8, 9
Hexadecimal	0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F

* Values other than noted above cannot be entered while each respective base is in effect. The letters B and D are displayed in lower case for hexadecimal.

5-1 Binary/octal/decimal/hexadecimal conversions

EXAMPLE	OPERATION	READ-OUT
	[MODE] [1] (BASE-*n* mode)	
Conversion of 22_{10} to binary	[DEC] 22 [BIN]	10110. b
to octal	[OCT]	26. o
to hexadecimal	[HEX]	16. H
Conversion of 513_{10} to binary	[DEC] 513 [BIN]	E b

* Conversion may sometimes be impossible if calculation range of original value is greater than range of result value.

Conversion of $7FFFFFFF_{16}$ to decimal	[HEX] 7FFFFFFF [DEC]	2147483647. d
Conversion of 4000000000_{8} to decimal	[OCT] 4000000000 [DEC]	−536870912. d
Conversion of 123456_{10} to octal	[DEC] 123456 [OCT]	361100. o
Conversion of 1100110_{2} to decimal	[BIN] 1100110 [DEC]	102. d

5-2 Negative expressions

- Negative values can be obtained by pressing the (-) key. The two's complement is produced for negation of binary, octal and hexadecimal values.

EXAMPLE	OPERATION	READ-OUT
	MODE 1 (BASE-*n* mode)	
Negation of 1010_2	BIN 1010 (-)	1111110110. b
Conversion to decimal	DEC	-10. d
Negation of 1_2	BIN 1 (-)	1111111111. b
Negation of 2_8	OCT 2 (-)	7777777776. O
Negation of 34_{16}	HEX 34 (-)	FFFFFFCC. H

5-3 Binary/octal/decimal/hexadecimal calculations

- Memory and parenthesis calculations can be used with binary, octal, and hexadecimal number systems.

	OPERATION	READ-OUT
	MODE 1 (BASE-*n* mode)	
$10111_2+11010_2=110001_2$	BIN 10111 + 11010 =	110001. b
$123_8\times ABC_{16}=37AF4_{16}$	OCT 123 × HEX ABC =	37AF4. H
$=228084_{10}$	DEC	228084. d
$1F2D_{16}-100_{10}=7881_{10}$	HEX 1F2D − DEC 100 =	7881. d
$=1EC9_{16}$	HEX	1EC9. H
$7654_8\div 12_{10}=334.3\cdots\cdots_{10}$	OCT 7654 ÷ DEC 12 =	334. d
$=516_8$	OCT	516. O

* Fractional parts of calculation results are truncated.

$110_2+456_8\times 78_{10}\div 1A_{16}=390_{16}$	BIN 110 + OCT 456 × DEC 78 ÷ HEX 1A =	390. H
$=912_{10}$	DEC	912. d

* Multiplication and division are given priority over addition and subtraction in mixed calculations.

$BC_{16}\times(14_{10}+69_{10})=15604_{10}$	HEX BC × ((DEC 14 + 69)) =	15604. d
$=3CF4_{16}$	HEX	3CF4. H
$\underline{23_8}+963_{10}=982_{10}$	OCT 23 SHIFT Rec + DEC 963 =	982. d
$\underline{23_8}+101011_2=111110_2$	MR + BIN 101011 =	111110. b
$2A56_{16}\times\underline{23_8}=32462_{16}$	HEX 2A56 × MR =	32462. H

6/FUNCTION CALCULATIONS

- Function calculations are performed in the COMP mode (MODE 0).
- * Scientific function keys can be utilized as subroutines of four basic calculations (including parenthesis calculations).
- * In some scientific functions, the display disappears momentarily while complicated formulas are being processed. So do not enter numerals or press a function key until the previous answer is displayed.
- * For each input range of the scientific functions, refer to page 41.

6-1 Degree-Minute-Second ↔ Decimal conversion

The °'" key converts the sexagesimal figure (degree, minute and second) to decimal notation. Operation of SHIFT °'" converts the decimal notation to the sexagesimal notation.

EXAMPLE	OPERATION	READ-OUT
$14°25'36"=14.42666667°$	14 °'"	14.
	25 °'"	14.41666667
	36 °'"	14.42666667
	SHIFT °'"	14°25°36.

6-2 Trigonometric/Inverse trigonometric functions

EXAMPLE	OPERATION	READ-OUT
$\sin(\frac{\pi}{6}\text{rad})=0.5$	"RAD" (MODE 5) π ÷ 6 = sin	0.5
$\cos 63°52'41"=0.440283084$	"DEG" (MODE 4) 63 °'" 52 °'" 41 °'"	63.87805555
	cos	0.440283084
$\tan(-35\text{gra})=-0.61280078$	"GRA" (MODE 6) 35 +/- tan	-0.61280078
$2\cdot\sin 45°\times\cos 65°$ $=0.597672477$	"DEG" 2 × 45 sin × 65 cos =	0.597672477
$\sin^{-1}\frac{1}{2}=30°$	"DEG" 2 1/x SHIFT sin	30.
$\cos^{-1}\frac{\sqrt{2}}{2}=0.785398163\text{rad}$	"RAD" 2 √ ÷ 2 = SHIFT cos	0.785398163
$\tan^{-1}0.6104=31.39989118°$	"DEG" (6104 SHIFT tan	31.39989118
$=31°23'59.61"$	SHIFT °'"	31°23°59.61
$\sin^{-1}0.8-\cos^{-1}0.9$ $=27°17'17.41"$	"DEG" (8 SHIFT sin − (9 SHIFT cos =	27.28816959
	SHIFT °'"	27°17°17.41

6-3 Hyperbolic/Inverse hyperbolic functions

EXAMPLE	OPERATION	READ-OUT
$\sinh 3.6 = 18.28545536$	3 ⊡ 6 hyp sin	18.28545536
$\tanh 2.5 = 0.986614298$	2 ⊡ 5 hyp tan	0.986614298
$\cosh 1.5 - \sinh 1.5 = 0.22313016$ $= e^{-1.5}$	1 ⊡ 5 SHIFT Mᵢₙ hyp cos −	M 2.352409615
	MR hyp sin =	M 0.22313016
	SHIFT ln	M −1.5
$\sinh^{-1} 30 = 4.094622224$	30 SHIFT hyp sin	4.094622224
$\cosh^{-1}\left(\frac{20}{15}\right) = 0.795365461$	20 ÷ 15 = SHIFT hyp cos	0.795365461
Solve $\tanh 4x = 0.88$ $x = \frac{\tanh^{-1} 0.88}{4} = 0.343941914$	⊡ 88 SHIFT hyp tan ÷ 4 =	0.343941914
$\sinh^{-1} 2 \times \cosh^{-1} 1.5 = 1.389388923$	2 SHIFT hyp sin ×	
	1 ⊡ 5 SHIFT hyp cos =	1.389388923

6-4 Common & Natural logarithms/Exponentiations (Antilogarithms, Exponentials, Powers and Roots)

EXAMPLE	OPERATION	READ-OUT
$\log 1.23 (= \log_{10} 1.23) = 0.089905111$	1 ⊡ 23 log	0.089905111
$\ln 90 (= \log_e 90) = 4.49980967$	90 SHIFT ln	4.49980967
$\log 456 \div \ln 456 = 0.434294481$	456 SHIFT Mᵢₙ log ÷ MR SHIFT ln =	M 0.434294481
$10^{1.23} = 16.98243652$	1 ⊡ 23 10^x	16.98243652
$e^{4.5} = 90.0171313$	4 ⊡ 5 SHIFT e^x	90.0171313
$10^{0.4} + 5 \cdot e^{-3} = 2.760821773$	⊡ 4 10^x + 5 × 3 +/− SHIFT e^x =	2.760821773
$5.6^{2.3} = 52.58143837$	5 ⊡ 6 SHIFT x^y 2 ⊡ 3 =	52.58143837

$123^{\frac{1}{7}} (= \sqrt[7]{123}) = 1.988647795$	123 SHIFT x^y 7 =	1.988647795
$(78-23)^{-12}$ $= 1.30511183 \times 10^{-21}$	(—) 78 − 23 (—) SHIFT x^y 12 +/− =	1.30511183 -21
$3^{12} + e^{10} = 553467.4658$	3 SHIFT x^y 12 + 10 SHIFT e^x =	553467.4658
$\log \sin 40° + \log \cos 35°$ $= -0.27856798$	"DEG" (MODE 4) 40 sin log + 35 cos log =	−0.27856798
	10^x	0.526540784

(The antilogarithm . . . . . 0.526540784)

$15^{\frac{1}{5}} + 25^{\frac{1}{6}} + 35^{\frac{1}{7}} = 5.090557037$

15 SHIFT x^y 5 + 25 SHIFT x^y 6 + 35 SHIFT x^y 7 = 5.090557037

* x^y and $x^{\frac{1}{y}}$ can be registered as a constant.

$4^{\underline{2.5}} = 32$	2 ⊡ 5 SHIFT x^y SHIFT x^y 4 =	K 32.
$0.16^{\underline{2.5}} = 0.01024$	⊡ 16 =	K 0.01024
$9^{\underline{2.5}} = 243$	9 =	K 243.

6-5 Square roots, Squares, Reciprocals, Factorials & Random numbers

EXAMPLE	OPERATION	READ-OUT
$\sqrt{2} + \sqrt{3} \times \sqrt{5} = 5.287196908$	2 √ + 3 √ × 5 √ =	5.287196908
$123 + 30^2 = 1023$	123 + 30 x^2 =	1023.
$\frac{1}{\frac{1}{3} - \frac{1}{4}} = 12$	3 1/x − 4 1/x = 1/x	12.
$8! (= 1 \times 2 \times 3 \times \cdots\cdots \times 7 \times 8) = 40320$	8 SHIFT x!	40320.
Generate a random number between 0.000 and 0.999.	SHIFT Ran#	0.570

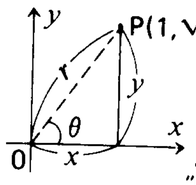
(Example)

6-6 Rectangular to polar co-ordinates conversion

Formula: $r = \sqrt{x^2 + y^2}$

$\theta = \tan^{-1}\frac{y}{x}$ $(-180° < \theta \leqq 180°)$

Ex.)
Find the length r and angle θ in radian when the point P is shown as $x = 1$ and $y = \sqrt{3}$ in the rectangular co-ordinates.



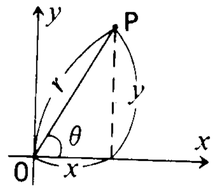
OPERATION	READ-OUT	
"RAD" (MODE 5)		
1 SHIFT R→P 3 √ =	2.	(r)
SHIFT X↔Y	1.047197551	(θ in radian)

6-7 Polar to Rectangular co-ordinates conversion

Formula: $x = r \cdot \cos\theta$

$y = r \cdot \sin\theta$

Ex.)
Obtain the values of x and y when the point P is shown as $\theta = 60°$ and length $r = 2$ in the polar co-ordinates.



OPERATION	READ-OUT	
"DEG" (MODE 4)		
2 SHIFT P→R 60 =	1.	(x)
SHIFT X↔Y	1.732050808	(y)

6-8 Applications

■Decibel (dB) conversion

Ex.)
How many dB of amplifier gain is in an amp with 5mW of input power and 43W of output power?

Formula: $dB = 10 \cdot \log_{10}\frac{P_2}{P_1}$

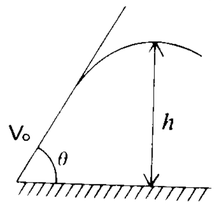
P_1 : Input power (W)
P_2 : Output power (W)

OPERATION	READ-OUT	
10 × (43 ÷ 5 EXP 3 +/-) log =	39.34498451	(dB)

■Parabolic movement

Ex.)
Obtain the height of a ball 3 seconds after throwing it at a 50° angle and at an initial velocity of 30 m/sec. (not calculating air resistance).

Formula: $h = V_0 t \sin\theta - \frac{1}{2}gt^2$

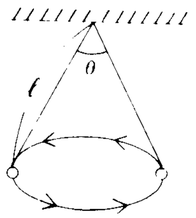


h : Height of ball at T seconds after thrown (m)
V_0 : Initial velocity (m/sec.)
t : Time (sec.)
θ : Throwing angle to level surface
g : Gravitational acceleration (9.8 m/sec.²)

OPERATION	READ-OUT	
"DEG" (MODE 4)		
30 × 3 × 50 sin − 1 ÷ 2 × 9 . 8 × 3 x^2 =	24.84399988	(m)

■Cycle of a conical pendulum

Ex.)
How many seconds is the cycle of a conical pendulum with a cord length of 30 cm and maximum swing angle of 90°?



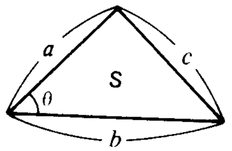
Formula: $T = 2\pi \cdot \sqrt{\frac{\ell \cdot \cos\frac{\theta}{2}}{g}}$

T : Cycle (sec.)
ℓ : Cord length (m)
θ : Maximum cord swing angle
g : Gravitational acceleration (9.8 m/sec.²)

OPERATION	READ-OUT	
"DEG" (MODE 4)		
2 × π × (. 3 × (90 ÷ 2) cos ÷ 9 . 8 √ =	0.924421332	(sec.)

■Triangle

Ex.)
Calculate the interior angle (θ) and area (S) of the triangle when the lengths of three sides (a, b and c) are given.



a: 18 m, b: 21 m, c: 12 m

Formula: $\cos\theta = \frac{a^2 + b^2 - c^2}{2ab}$

$S = \frac{1}{2}ab \cdot \sin\theta$

OPERATION	READ-OUT	
"DEG" (MODE 4) 18 Kin 1 x^2 + 21 Kin 2 x^2 − 12 x^2 = ÷		
(•••) Kout 1 × Kout 2 × SHIFT Mem 2 (•••) = SHIFT cos SHIFT tan	34°46°19.	(θ)
sin × MR ÷ 2 =	107.7888561	(m^2)

■Pro-rating

Division	Sales amount	%
A	$ 84	22.4
B	153	40.8
C	138	36.8
Total	375	100.0

OPERATION	READ-OUT	
(•••) 84 + 153 + 138 (•••) ÷	375.	
100 ÷ ÷ 84 = SHIFT Mem	M K 22.4	
153 M+	M K 40.8	
138 M+	M K 36.8	
MR	M K 100.	

■Time calculations

1 hr. 27 min. 58 sec.
1 hr. 35 min. 16 sec.
+) 1 hr. 41 min. 12 sec.
4 hr. 44 min. 26 sec.
Average: 1 hr. 34 min. 48.67 sec.

OPERATION	READ-OUT
1 (•••) 27 (•••) 58 (•••) +	
1 (•••) 35 (•••) 16 (•••) +	
1 (•••) 41 (•••) 12 (•••) = SHIFT (•••)	4°44°26.
÷ 3 = SHIFT (•••)	1°34°48.67

7/STATISTICAL CALCULATIONS

* Be sure to press SHIFT AC in sequence prior to starting a statistical calculation.

7-1 Standard deviation

* Set the function mode to "SD" by pressing MODE 3.

Ex.) Find σ_{n-1}, σn, $\bar{x}$, n, Σx and Σx^2 based on the data 55, 54, 51, 55, 53, 53, 54, 52.

OPERATION	READ-OUT
"SD" SHIFT AC 55 DATA 54 DATA 51 DATA 55 DATA 53 DATA DATA	
54 DATA 52 DATA	52.
(Sample standard deviation) SHIFT $x\sigma_{n-1}$	1.407885953
(Population standard deviation) SHIFT $x\sigma n$	1.316956719
(Arithmetic mean) SHIFT $\bar{x}$	53.375
(Number of data) Kout 7	8.
(Sum of value) Kout Σx	427.
(Sum of square value) Kout Σx^2	22805.

Calculate the unbiased variance and the deviation between each data item and the average.

(Subsequently) SHIFT $x\sigma_{n-1}$ x^2	1.982142857	(Unbiased variance)
SHIFT $\bar{x}$ − − 55 =	1.625	($55 - \bar{x}$)
54 =	0.625	($54 - \bar{x}$)
51 =	−2.375	($51 - \bar{x}$)
⋮	⋮	

Note: The sample standard deviation σ_{n-1} is defined as

$$\sqrt{\frac{\Sigma x^2 - \frac{(\Sigma x)^2}{n}}{n-1}}$$

the population standard deviation σn is defined as

$$\sqrt{\frac{\Sigma x^2 - \frac{(\Sigma x)^2}{n}}{n}}$$

and the arithmetical mean $\bar{x}$ is defined as $\frac{\Sigma x}{n}$

* Pressing $x\sigma_{n-1}$, $x\sigma n$, $\bar{x}$, n, Σx, or Σx^2 key need not be done sequentially.

Ex.) Find n, $\bar{x}$ & σ_{n-1} based on the data: 1.2, −0.9, −1.5, 2.7, −0.6, 0.5, 0.5, 0.5, 0.5, 1.3, 1.3, 1.3, 0.8, 0.8, 0.8, 0.8, 0.8.

OPERATION		READ-OUT
"SD"	SHIFT KAC 1 ⊡ 2 DATA ⊡ 9 +/− DATA	−0.9
① (Mistake)	2 ⊡ 5 +/−	−2.5
①′ (To correct)	C	0.
	1 ⊡ 5 +/− DATA	−1.5
	2 ⊡ 7 DATA	2.7
② (Mistake)	DATA	2.7
③ (Mistake)	1 ⊡ 6 +/− DATA	−1.6
③′ (To correct)	SHIFT DEL	−1.6
	⊡ 6 +/− DATA	−0.6
②′ (To correct)	2 ⊡ 7 SHIFT DEL	2.7
	⊡ 5 ×	0.5
	4 DATA	0.5
④ (Mistake)	1 ⊡ 4 ×	1.4
④′ (To correct)	AC	0.
	1 ⊡ 3 × 3 DATA	1.3
	⊡ 8 ×	0.8
⑤ (Mistake)	6 DATA	0.8
⑤′ (To correct)	⊡ 8 × 6 SHIFT DEL	0.8
	⊡ 8 × 5 DATA	0.8
	Kout n	17.
	SHIFT $\bar{x}$	0.635294117
	SHIFT $x\sigma_{n-1}$	0.95390066

7-2 Regression analysis

* Set the function mode to "LR" by pressing MODE 2.

■ Linear regression

Formula: $y = A + Bx$

$$B = \frac{n \cdot \Sigma xy - \Sigma x \cdot \Sigma y}{n \cdot \Sigma x^2 - (\Sigma x)^2}$$

$$A = \frac{\Sigma y - B \cdot \Sigma x}{n}$$

$$r = \frac{n \cdot \Sigma xy - \Sigma x \cdot \Sigma y}{\sqrt{\{n \cdot \Sigma x^2 - (\Sigma x)^2\}\{n \cdot \Sigma y^2 - (\Sigma y)^2\}}}$$

Ex.) Results from measuring the length and temperature of a steel bar.

temp.	length
10°C	1003 mm
15	1005
20	1010
25	1008
30	1014

Find the constant term (A), regression coefficient (B), correlation coefficient (r) and estimated values $(\hat{x}, \hat{y})$ using the above figures as a basis.

	OPERATION	READ-OUT	
"LR"	SHIFT KAC 10 x_o,y_o	10.	
	1003 DATA	1003.	
	15 x_o,y_o 1005 DATA	1005.	
	20 x_o,y_o 1010 DATA	1010.	
	25 x_o,y_o 1008 DATA	1008.	
	30 x_o,y_o 1014 DATA	1014.	
	SHIFT A	998.	(A)
	SHIFT B	0.5	(B)
	SHIFT r	0.919018277	(r)
(When the temp. is 18°C)	18 $\hat{y}$	1007.	(mm)
(When the length is 1000 mm)	1000 SHIFT $\hat{x}$	4.	(°C)

Note: Σx^2, Σx, n, Σy^2, Σy, Σxy, $\bar{x}$, $x\sigma_n$, $x\sigma_{n-1}$, $\bar{y}$, $y\sigma_n$, $y\sigma_{n-1}$; A, B and r are respectively obtained by pressing a numeral key (1 to 9) after the Kout or SHIFT key.

*** Correction of data entry**

Ex.)

xi	2	3	2	3	2	4
yi	3	4	4	5	5	5

OPERATION		READ-OUT
"LR"	SHIFT KAC 2 x_o,y_o 3 DATA	3.
① (Mistake)	4	4.
①′ (To correct)	C	0.
	3 x_o,y_o	3.
	4 DATA	4.
② (Mistake)	3 x_o,y_o	3.
②′ (To correct)	2 x_o,y_o	2.
	4 DATA	4.
③ (Mistake)	1 x_o,y_o	1.
	5 DATA	5.
③′ (To correct)	SHIFT DEL	5.
	3 x_o,y_o 5 DATA	5.
	2 x_o,y_o	2.
④ (Mistake)	4 DATA	4.
	4 x_o,y_o	4.
⑤ (Mistake)	6 DATA	6.
⑤′ (To correct)	SHIFT DEL	6.
	4 x_o,y_o 5 DATA	5.
④′ (To correct)	2 x_o,y_o 4 SHIFT DEL	4.
	2 x_o,y_o 5 DATA	5.

These ways of correction can also be applied to logarithmic, exponential or power regression.

■ Logarithmic regression

Formula: $y = A + B \cdot \ln x$

* Input data items are the logarithm of x ($\ln x$), and y which is the same as in linear regression.
* Operation for calculating and correcting regression coefficients are basically the same as in linear regression. Operate the sequence x SHIFT ln $\hat{y}$ to obtain estimator $\hat{y}$ and y SHIFT $\hat{x}$ SHIFT e^x for estimator $\hat{x}$. Note that $\Sigma \ln x$, $\Sigma (\ln x)^2$, and $\Sigma \ln x \cdot y$ are obtained instead of Σx, Σx^2, and Σxy respectively.

Ex.)

xi	29	50	74	103	118
yi	1.6	23.5	38.0	46.4	48.9

Find A, B, r, $\hat{x}$ and $\hat{y}$ using the above figures as a basis.

OPERATION		READ-OUT	
"LR"	SHIFT KAC 29 SHIFT ln x_o,y_o	3.36729583	
	1 ⊡ 6 DATA	1.6	
	50 SHIFT ln x_o,y_o 23 ⊡ 5 DATA	23.5	
	74 SHIFT ln x_o,y_o 38 DATA	38.	
	103 SHIFT ln x_o,y_o 46 ⊡ 4 DATA	46.4	
	118 SHIFT ln x_o,y_o 48 ⊡ 9 DATA	48.9	
	SHIFT A	−111.128397	(A)
	SHIFT B	34.02014743	(B)
	SHIFT r	0.994013945	(r)
(When xi is 80)	80 SHIFT ln $\hat{y}$	37.94879479	($\hat{y}$)
(When yi is 73)	73 SHIFT $\hat{x}$ SHIFT e^x	224.1541318	($\hat{x}$)

■ Exponential regression

Formula: $y = A \cdot e^{B \cdot x}$

* Input data items are the logarithm of y ($\ln y$) and x which is the same as in linear regression.
* Operation for correction is basically the same as in linear regression. Operate SHIFT A SHIFT e^x to obtain coefficient A, x $\hat{y}$ SHIFT e^x for estimator $\hat{y}$, and y SHIFT ln SHIFT $\hat{x}$ for estimator $\hat{x}$. Note that $\Sigma \ln y$, $\Sigma (\ln y)^2$, and $\Sigma x \cdot \ln y$ are obtained instead of Σy, Σy^2, and Σxy.

Ex.)

xi	6.9	12.9	19.8	26.7	35.1
yi	21.4	15.7	12.1	8.5	5.2

Find A, B, r, $\hat{x}$ and $\hat{y}$ using the above figures as a basis.

OPERATION	READ-OUT	
"LR"		
[SHIFT] [KAC] 6 [·] 9 [x_o,y_o]	6.9	
21 [·] 4 [SHIFT] [ln] [DATA]	3.063390922	
12 [·] 9 [x_o,y_o] 15 [·] 7 [SHIFT] [ln] [DATA]	2.753660712	
19 [·] 8 [x_o,y_o] 12 [·] 1 [SHIFT] [ln] [DATA]	2.493205453	
26 [·] 7 [x_o,y_o] 8 [·] 5 [SHIFT] [ln] [DATA]	2.140066164	
35 [·] 1 [x_o,y_o] 5 [·] 2 [SHIFT] [ln] [DATA]	1.648658626	
[SHIFT] [A] [SHIFT] [e^x]	30.49758743	(A)
[SHIFT] [B]	−0.0492037	(B)
[SHIFT] [r]	−0.99724735	(r)
(When xi is 16) 16 [$\hat{y}$] [SHIFT] [e^x]	13.87915739	($\hat{y}$)
(When yi is 20) 20 [SHIFT] [ln] [SHIFT] [$\hat{x}$]	8.57486805	($\hat{x}$)

■ Power regression

Formula: $y = A \cdot x^B$

* Input data items are $\ln x$ and $\ln y$.
* Operation for correction is basically the same as in linear regression. Operate [SHIFT] [A] [SHIFT] [e^x] to obtain coefficient A, x [SHIFT] [ln] [$\hat{y}$] [SHIFT] [e^x] for estimator $\hat{y}$, and y [SHIFT] [ln] [$\hat{x}$] [SHIFT] [e^x] for estimator $\hat{x}$. Note that $\Sigma \ln x$, $\Sigma (\ln x)^2$, $\Sigma \ln y$, $\Sigma (\ln y)^2$, and $\Sigma \ln x \cdot \ln y$ are obtained instead of Σx, Σx^2, Σy, Σy^2, and Σxy respectively.

Ex.)

xi	28	30	33	35	38
yi	2410	3033	3895	4491	5717

Find A, B, r, $\hat{x}$ and $\hat{y}$ using the above figures as a basis.

OPERATION	READ-OUT	
"LR"		
[SHIFT] [KAC] 28 [SHIFT] [ln] [x_o,y_o]	3.33220451	
2410 [SHIFT] [ln] [DATA]	7.787382026	
30 [SHIFT] [ln] [x_o,y_o] 3033 [SHIFT] [ln] [DATA]	8.017307508	
33 [SHIFT] [ln] [x_o,y_o] 3895 [SHIFT] [ln] [DATA]	8.267448958	
35 [SHIFT] [ln] [x_o,y_o] 4491 [SHIFT] [ln] [DATA]	8.409830673	
38 [SHIFT] [ln] [x_o,y_o] 5717 [SHIFT] [ln] [DATA]	8.651199471	
[SHIFT] [A] [SHIFT] [e^x]	0.238801299	(A)
[SHIFT] [B]	2.771865947	(B)
[SHIFT] [r]	0.998906243	(r)
(When xi is 40) 40 [SHIFT] [ln] [$\hat{y}$] [SHIFT] [e^x]	6587.67582	($\hat{y}$)
(When yi is 1000) 1000 [SHIFT] [ln] [SHIFT] [$\hat{x}$] [SHIFT] [e^x]	20.26225439	($\hat{x}$)

8/PROGRAMMED CALCULATIONS

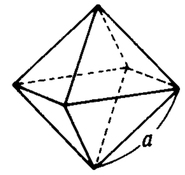
* This calculator has a program memory of 135 steps. Up to four programmed procedures of calculation may be stored in the memory.
* To store a program (mathematical procedure) in the calculator, execute ordinary (i.e. manual) calculation in the LRN mode (press [MODE] [EXP]) only once.
* Now the calculator has memorized the program. Input data and press the [RUN] key, and the calculator executes the program with the data. This is very convenient for repeating calculations with varying sets of data.

■ How to store and execute programs

Example 1:

Calculate the surface areas (S) of regular octahedrons whose ridges are respectively 10, 7 and 15 cm long.

Formula: $S = 2\sqrt{3}a^2$



Ridge length (a)	Surface area
10 cm	(346.41) cm²
7	(169.74)
15	(779.42)

* Values enclosed with parentheses are to be obtained.

● The following sequence of key operations realizes a mathematical procedure of the above formula.

2 [×] 3 [√] [×] 10 [x^2] [=] → S

↑ Value of a (data)

● Operate the above sequence in the LRN mode ([MODE] [EXP]). Note that [ENT] must be pressed prior to data entry (the value of a in this case).

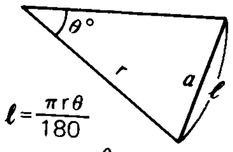
OPERATION		READ-OUT	
(Select LRN mode)	[MODE] [EXP]	LRN 0. IIIV	LRN lit, IIIV blinking.
(Designate program No.)	[1]	LRN 0. I	Select a program area I, II, III or IV.
	2	LRN 2. I	
	[×]	LRN 2. I	
	3	LRN 3. I	
	[√]	LRN 1.732050808 I	
	[×]	LRN 3.464101615 I	The mathematical procedure is stored in I.
(Input data)	[ENT] 10	LRN 10. I ENT	
	[x^2]	LRN 100. I	
	[=]	LRN 346.4101615 I	S for a = 10

Execution of the program stored

(LRN disappears)

(Select RUN mode) MODE ·	346.4101615
(Designate program No.) I	3.464101615 I ENT
7 RUN	169.7409791 S for a = 7
I 15 RUN	779.4228634 S for a = 15

Example 2:
Calculate the length, ℓ of the arc and the length, a of the chord of a sector with radius and radii making an angle of $\theta°$.



$\ell = \frac{\pi r \theta}{180}$

$a = 2r\sin\frac{\theta}{2}$

Radius (r)	Angle of radii (θ)	Arc length (ℓ)	Chord length (a)
10 cm	60°	(10.47) cm	(10) cm
12	42°34′	(8.91)	(8.71)
15	36°	(9.42)	(9.27)

* The values enclosed with parentheses are to be obtained.

OPERATION	READ-OUT
(Select LRN mode) MODE EXP	LRN 0. I II III IV
(Designate program No.) II	LRN 0. II
MODE 4 ENT 10	LRN DEG 10. II ENT (r → To K1 register)
Kin 1 × ENT 60	LRN DEG 60. II ENT (θ → To K2 register)
Kin 2 × EXP π ÷ 180 =	
SHIFT HLT	LRN DEG 10.47197551 II (HLT for displaying result (ℓ))
2 Kin × 1 Kin ÷ 2	(K1 x 2, K2 ÷ 2)
Kout 2 sin Kin × 1	($\sin\frac{\theta}{2}$ x K1)
Kout 1	LRN DEG 10. II (Result (a))

Execution of the program stored.

(LRN disappears)

(Select RUN mode) MODE ·	DEG 10.
(Designate program No.) II	DEG 10. II ENT
(Input r) 12 RUN	DEG 12. II ENT
(Input θ) 42 °‴ 34 °‴ RUN	DEG 8.915141819 II (Result (ℓ))
(Subsequently) RUN	DEG 8.711524731 (Result (a))
II 15 RUN 36 RUN	DEG 9.424777961 II (Result (ℓ))
(Subsequently) RUN	DEG 9.270509832 (Result (a))

■ Program step

- The program is stored (written) in the calculator as shown below.

No. of steps	Program
1	I 2
2	×
3	3
4	√
5	×
6	ENT
7	x^2
8	=
9	II MODE 4
10	ENT
11	Kin 1
12	×
13	ENT
14	Kin 2
15	×
16	π
17	÷
18	1
19	8
20	0
21	=
22	SHIFT HLT
23	2
24	Kin x 1
25	Kin ÷ 2
26	Kout 2
27	sin
28	Kin x 1
29	Kout 1
30	
31	
⋮	⋮
36	
37	
38	

- The program capacity is 135 steps. The program may be divided into four areas (I, II, III and IV) and each can be used independently of the other.
- An error results ("E" displayed) when there is an attempt to write the 136th step. No subsequent steps can be written. In this case, press AC to release the error check.
- After the program is started, instruction steps are executed one after another and execution does not stop. But it is needed to halt execution for inputting a data or reading a result. This is accomplished by ENT and SHIFT HLT. When the end of a program is reached, execution stops automatically and the state is displayed. So, HLT may be absent.
- Each function comprises a step of program. The depression of keys in a certain sequence produces a single program step if it generates a single function.
  1) Functions generated by the depression of a single key
     Ex.) Numeral value, +/−, +, −, ×, ÷, =, [(,)], sin, log, ENT, ...
  2) Functions generated by the depression of a two-key sequence
     Ex.) hyp sin, SHIFT $\sin^{-1}$, SHIFT X↔Y, SHIFT x^y, SHIFT R→P, Kin 2, SHIFT RAN#, ...
  3) Functions generated by the depression of a three-key sequence
     Ex.) SHIFT X↔K 5, SHIFT hyp $\sin^{-1}$, MODE 8 3 (Assignment for the number of significant digits), Kin x 3 (Multiplication with contents of K3 register), ...
- * If you have misoperated when writing a program (i.e. in the LRN mode), press the sequence of SHIFT PCL and perform the correct operation.
- * The depression of a data entry key (·, 0 – 9) followed by EXP, +/−, °‴ or ← will not be written in if such a sequence immediately follows the depression of ENT. Note that one of the functions which does not follow a numeric data will be written in as a step.

Example:

ENT 6 °‴ 6 °‴ 6 °‴

Not written in

ENT 6 °‴ °‴ °‴

Not written in — Written (2 steps)

- * Besides the program steps required for operations, 1 additional step is required for program specification.

Example: 2 steps are required when I and II are used.

■ How to erase a program

An old program will be automatically overwritten by a new program if the same program number is assigned to them.
To erase a program for making corrections or erase all 135 steps, operate the following sequence.

- To erase a single program (I, II, III or IV).

  [MODE] [EXP] [I] ([II], [SHIFT] [III] or [SHIFT] [IV]) [SHIFT] [PCL]

  ↑ Selects the LRN mode.

- To erase all programs I to IV.

  [MODE] [EXP] [SHIFT] [PCL]

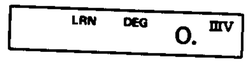
■ Calculation mode specification in the LRN mode (COMP, BASE-*n*, LR, SD)

Besides standard function calculations, binary, octal, decimal, hexadecimal, standard deviation, and regression calculations can all be included within programs. In such cases, however, calculation mode specification must also be stored in the program. This mode specification is performed after specification of the LRN mode using the procedure outlined below.

Example: Store the BASE-*n* mode in program area II.

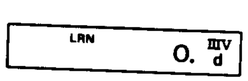
(1) [MODE] [EXP] (LRN mode)

[MODE] [EXP]



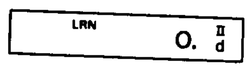
(2) Calculation mode (BASE-*n* mode) specification
[MODE] [1]

[MODE] [1]



(3) Press the program area key [II].

[II]



Other calculation modes can be stored in programs following the same procedure outlined above.

* The calculation mode can be specified following program area specification, but the operation following the program area key requires one step. Therefore, the operation outlined above allows more efficient use of memory space.

Example:

[MODE] [EXP] . . . LRN mode specification

[II] . . . . . Program area specification

[MODE] [1] . . . BASE-*n* mode specification: 1 step

■ Jump instructions

There are two types of jump instructions as follows.

1. Unconditional return to the first step of program: RTN

Write the sequence of [SHIFT] [RTN] at the end of a program to execute it repeatedly.

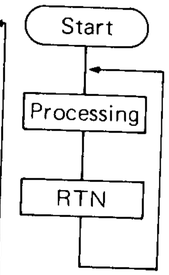
Example: Let us use the unconditional return instruction in the regular octahedron program explained on page 32. (In this case, the formula must be modified to $S = a^2 \times 2\sqrt{3}$.)

Operation: [MODE] [EXP] [I]
[ENT] 10 [x^2] [×] 2 [×] 3 [$\sqrt{\ }$] [=] [SHIFT] [RTN]

↑ Value of *a*　　↑ Return instruction

Step No.	Instruction step
1	ENT
2	x^2
3	×
4	2
5	×
6	3
7	$\sqrt{\ }$
8	=
9	SHIFT RTN

Flowchart



OPERATION		READ-OUT	
(Select RUN mode)	[MODE] [·]	0.	
(Designate program No.)	[I]	0. I ENT	
(For *a* = 7)	7 [RUN]	169.7409791 I ENT	Result S for *a* = 7
(For *a* = 15)	15 [RUN]	779.4228634 I ENT	Result S for *a* = 15

* If a program includes an RTN instruction but neither ENT nor HLT, the program will, once started, not stop in an endless loop. To stop the program in such a case, press [AC].

2. Return to the first step of program depending on the condition of the contents of the X-register (display):

$x > 0$, $x \leqq M$

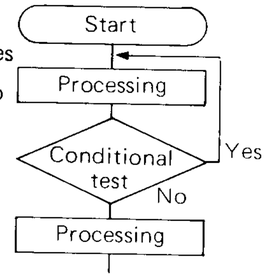
- $x > 0$: Return to the first step of program if the contents of the X-register is greater than zero and go to the next step otherwise.
- $x \leqq M$: Return to the first step of program if the contents of the X-register is equal to or smaller than the contents of the M-register and otherwise go to the next step.

Example: Find the maximum of 456, 852, 321, 753, 369, 741, 684 and 643.

Operation: [MODE] [EXP] [II]
[ENT] [SHIFT] [$x \leqq M$] [SHIFT] [Min] [SHIFT] [RTN]

Step No.	Instruction step
1	ENT
2	SHIFT $x \leqq M$
3	SHIFT Min
4	SHIFT RTN

Flowchart



OPERATION		READ-OUT	
[MODE] [·] [AC] [SHIFT] [Min]		0.	Memory cleared
(Designate II)	[II]	0. II	
(Input data)	456 [RUN]	456. II [ENT]	
	852 [RUN]	852. II [ENT]	
	321 [RUN]	321. II [ENT]	
	753 [RUN]	753. II [ENT]	
	369 [RUN]	369. II [ENT]	
	741 [RUN]	741. II [ENT]	
	684 [RUN]	684. II [ENT]	
	643 [RUN]	643. II [ENT]	
	[MR]	852. II [ENT]	Maximum displayed

■ Applications

• Permutation and combination

Calculate nPr and nCr for (n = 10: r = 4) and (n = 25: r = 5).

$$\left[nPr = \frac{n!}{(n-r)!},\ nCr = \frac{n!}{r!\,(n-r)!} \right]$$

Programming:

[MODE] [EXP]
↓
"LRN" displayed

[I] [ENT] 10 [Kin] [1] [ENT] 4 [Kin] [2]
↓ (Value of n) ↓ (Value of r)

[Kout] [1] [SHIFT] [$x!$] [÷] [(] [Kout] [1] [−] [Kout] [2] [)] [SHIFT] [$x!$] [=] ····· 5040 (Permutation)

[II] [ENT] 10 [Kin] [1] [ENT] 4 [Kin] [2]
↓ (Value of n) ↓ (Value of r)

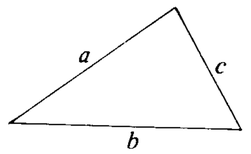
[Kout] [1] [SHIFT] [$x!$] [÷] [Kout] [2] [SHIFT] [$x!$] [÷] [(] [Kout] [1] [−] [Kout] [2] [)]
[SHIFT] [$x!$] [=] ····· 210 (Combination)

Operation:

[MODE] [·]

[I] 25 [RUN] 5 [RUN] ····· 6375600 (Permutation)
[II] 25 [RUN] 5 [RUN] ····· 53130 (Combination)

• Calculate the area of a triangle when the lengths of the three sides are given.



$$\left[s = \frac{a+b+c}{2},\quad S = \sqrt{s\,(s-a)\,(s-b)\,(s-c)} \right]$$

How large is S when a = 18, b = 22 and c = 31?
How large is S when a = 9.7, b = 13.4 and c = 6.5?

Programming:

[MODE] [EXP]
↓
"LRN" displayed

[I] [ENT] 18 [Kin] [1] [+] [ENT] 22 [Kin] [2] [+] [ENT] 31 [Kin] [3]
[=] [÷] 2 [=] [Kin] [4]
[×] [(] [Kout] [4] [−] [Kout] [1] [)] [×] [(] [Kout] [4] [−] [Kout] [2] [)]
[×] [(] [Kout] [4] [−] [Kout] [3] [)] [=] [√] ····· 194.2702692 (Area S)

Operation:

[MODE] [·]

[I] 9 [·] 7 [RUN] 13 [·] 4 [RUN] 6 [·] 5 [RUN] ····· 29.61549594 (Area S)

• Sort sales slips by item code and add up the total of each item (for five items).

Code	Amount
3	2870
2	1960
5	3850
5	1250
1	2500
2	2310
3	1850
5	4370
3	5360
1	2220
2	1450
4	6120
1	3100

➡

Code	Amount
1	7820
2	5720
3	10080
4	6120
5	9470

Programming:

[MODE] [EXP]
↓
"LRN" displayed

[I] [ENT] [SHIFT] [Mi+] [ENT] [Kin] [6] . . . . . (A)
[Kin] [+] [5] [5] [SHIFT] [x≤M] . . . . . (B)
[Kout] [6] [Kin] [−] [5] [Kin] [+] [4] [4] [SHIFT] [x≤M] . . . . . (C)
[Kout] [6] [Kin] [−] [4] [Kin] [+] [3] [3] [SHIFT] [x≤M] . . . . . (D)
[Kout] [6] [Kin] [−] [3] [Kin] [+] [2] [2] [SHIFT] [x≤M] . . . . . (E)
[Kout] [6] [Kin] [−] [2] [Kin] [+] [1] [1] [SHIFT] [RTN] . . . . . (F)

[II] [Kout] [1] [SHIFT] [HLT] [Kout] [2] [SHIFT] [HLT]
[Kout] [3] [SHIFT] [HLT] [Kout] [4] [SHIFT] [HLT] [Kout] [5] . . . . . (G)

(A) Sets to input the code numbers into independent memory (M) and the amount to K the constant memory (K6).
(B) Adds amount to K5 (still on display) temporarily and compares the code number (stored in M) with "5". If code number is 5, then amount is kept in K5 and returns to first line. If code number is less than 5, proceeds to the next line.
(C) Subtracts the amount (stored in K6) from K5 and adds to K4 temporarily. Compares the code number with "4": if 4, then returns to first line, if less than 4 proceeds to next.
(D), (E) Repeats same thing for code numbers 3 and 2.
(F) Subtracts the amount (stored in K6) from K2 and adds to K1. Returns to first step.
(G) Displays each amount accumulated per code number (contents of K1 through K5).

Operation:

[MODE] [•]

[SHIFT] [KAC] [I] 3 [RUN] 2870 [RUN] 2 [RUN] 1960 [RUN] 5 [RUN] 3850 [RUN] 5 [RUN] 1250 [RUN]
1 [RUN] 2500 [RUN] 2 [RUN] 2310 [RUN] 3 [RUN] 1850 [RUN] 5 [RUN] 4370 [RUN]
3 [RUN] 5360 [RUN] 1 [RUN] 2220 [RUN] 2 [RUN] 1450 [RUN] 4 [RUN] 6120 [RUN]
1 [RUN] 3100 [RUN]

[II] ..... 7820 (Amount of code No. 1)
[RUN] ..... 5720 (Amount of code No. 2)
[RUN] ..... 10080 (Amount of code No. 3)
[RUN] ..... 6120 (Amount of code No. 4)
[RUN] ..... 9470 (Amount of code No. 5)

• Calculation for loan-repayment (Equally divided monthly repayment)

Formula $P = PV\dfrac{i}{1-(1+i)^{-n}}$

P: Amount of monthly repayment
PV: Amount of loan (Kin 1)
i: Monthly interest (Kin 2)
n: Number of times of repayment (Kin 3)

* The amount of repayment will be calculated in units of dollar by counting 50 cents or more as 1 dollar and disregarding the rest.

1) We borrow $30,000 at an annual interest of 7.65% for 10 years. What is the amount of monthly repayment?
2) We borrow $5,000 at an annual interest of 5.05% for 5 years. What is the amount of monthly repayment?

Programming:

[MODE] [EXP]
↓
"LRN" displayed

[I] [ENT] 30000 [Kin] [1]
[ENT] 7 [•] 65 [÷] 12 [EXP] 2 [=] [Kin] [2]
[ENT] 10 [×] 12 [=] [Kin] [3]
[Kout] [1] [×] [Kout] [2] [÷] [(] 1 [−] [(] 1 [+] [Kout] [2] [)] [SHIFT] [x^y] [Kout] [3] [+/−] [)]
[=] [MODE] [7] [0] .....358 (Amount of monthly repayment)

Operation:

[MODE] [•]

[I] 5000 [RUN] 5 [•] 05 [RUN] 5 [RUN] .....94 (Amount of monthly repayment)

9/SPECIFICATIONS

■ Basic features

- **Basic operations:** 4 basic calculations, constants for +/−/×/÷/x^y/$x^{\frac{1}{y}}$, and parenthesis calculations.
- **Built-in functions:** trigonometric/inverse trigonometric functions (with angle in degrees, radians or grads), hyperbolic/inverse hyperbolic functions, logarithmic/exponential functions, reciprocals, factorials, square roots, powers, roots, decimal ↔ sexagesimal conversion, conversion of co-ordinate system (R→P, P→R), random number, π, percentages, and binary/octal/decimal/hexadecimal calculations.
- **Statistical functions:** standard deviation, linear regression, logarithmic regression, exponential regression, and power regression.
- **Memory:** 1 independent memory and 6 constant memories.
- **Capacity:**

	Input range	Output accuracy
Entry/basic functions:	10 digit mantissa, or 10 digit mantissa plus 2 digit exponent up to $10^{\pm 99}$.	
Scientific functions:		
$\sin x/\cos x/\tan x$	$\|x\| < 1440^\circ$ (8π rad, 1600 gra)	±1 in the 10th digit
$\sin^{-1}x/\cos^{-1}x$	$\|x\| \leqq 1$	— " —
$\tan^{-1}x$	$\|x\| < 1 \times 10^{100}$	— " —
$\sinh x/\cosh x$	$\|x\| \leqq 230.2585092$	— " —
$\tanh x$	$\|x\| < 1 \times 10^{100}$	— " —
$\sinh^{-1}x$	$\|x\| < 5 \times 10^{99}$	— " —
$\cosh^{-1}x$	$1 \leqq x < 5 \times 10^{99}$	— " —
$\tanh^{-1}x$	$\|x\| < 1$	— " —
$\log x/\ln x$	$1 \times 10^{-99} \leqq x \leqq 10^{100}$	— " —
e^x	$-10^{100} < x \leqq 230.2585092$	— " —
10^x	$-10^{100} < x < 100$	— " —
x^y	$\begin{cases} x > 0 \rightarrow -1 \times 10^{100} < y \cdot \log x < 100 \\ x = 0 \rightarrow y > 0 \\ x < 0 \rightarrow y$: integer or $\pm 1/2n+1$ (n: integer)	— " —
$x^{\frac{1}{y}}$ ($\sqrt[y]{x}$)	$\begin{cases} x > 0 \rightarrow -10^{100} < 1/y \cdot \log x < 100 \\ x = 0 \rightarrow y > 0 \\ x < 0 \rightarrow y$: odd number or $\pm 1/n$ (n: natural number)	— " —
$\sqrt{x}$	$0 \leqq x < 1 \times 10^{100}$	— " —
$\sqrt[3]{x}$	$\|x\| < 1 \times 10^{100}$	— " —
x^2	$\|x\| < 1 \times 10^{50}$	— " —
$1/x$	$\|x\| < 1 \times 10^{100}, x \neq 0$	— " —
$x!$	$0 \leqq x \leqq 69$ (x: natural number)	— " —
POL → REC	$\|\theta\| < 1440^\circ$ (8π rad, 1600 gra)	— " —
REC → POL	$\sqrt{x^2+y^2} < 1 \times 10^{100}$	— " —
	$\|r\| < 1 \times 10^{100}$	
° ' "	up to second	
π	10 digits	

Binary	Positive :	$0 \leqq x \leqq 111111111$
	Negative:	$1000000000 \leqq x \leqq 1111111111$
Octal	Positive :	$0 \leqq x \leqq 3777777777$
	Negative:	$4000000000 \leqq x \leqq 7777777777$
Decimal	Positive :	$0 \leqq x \leqq 9999999999$
	Negative:	$-999999999 \leqq x \leqq 0$
Hexadecimal	Positive :	$0 \leqq x \leqq 7FFFFFFF$
	Negative:	$80000000 \leqq x \leqq FFFFFFFF$

* Errors are cumulative with such internal continuous calculations as x^y, $x^{\frac{1}{y}}$, $x!$, $\sqrt[3]{\ }$ so accuracy may be adversely affected.
* In $\tan x$, $|x| \neq 90^\circ \times (2n+1)$, $|x| \neq \pi/2\text{rad} \times (2n+1)$, $|x| \neq 100\text{gra} \times (2n+1)$ (n is an integer.)
* With $\sinh x$ and $\tanh x$, errors are cumulative and adversely affected when $x = 0$.

■ Programmable features:

- **Total number of steps:** up to 135 (1 step performs a function).
- **Jump:** Unconditional jump (RTN), conditional jump ($x > 0$, $x \leqq M$).
- **Number of programs storable:** up to 4 (I, II, III and IV).

■ Decimal point:

Full floating with underflow.

■ Read-out:

Liquid crystal display.

■ Power consumption:

0.0005 W

■ Power source:

One lithium battery (Type: CR2025C).
The unit gives approximately 1300 hours continuous operation on type CR2025C.

■ Ambient temperature range:

0°C – 40°C (32°F – 104°F)

■ Dimensions:

9H x 72W x 129mmD ($\frac{3}{8}$"H x $2\frac{7}{8}$"W x $5\frac{1}{8}$"D)

■ Weight:

75 g (2.6 oz) including battery.